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MINERAL SUBSTANCES OF AQUATIC AND TERRESTRIAL VEGETATION IN THE STORAGE TANK AT KISKÖRE

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Abstract

The analysis of 72 plant specimens was carried out for 11 elements at the end of June, 1982. Apart from the species of the littoral zone, the retraceable species of Myriophyllo-Potametum and Nymphaeetum albo-luteae were also evaluated. In contrast with the alarming salt and heavy metal accumulation observed in the flood-plain of the Tisza, the composition of the vegetation is the customary in the water of the storage tank and on the overlands protruding as islands. From the more critical elements the averages of the 54 terrestrial specimens were as follows P=2,0 g/kg, Mg=1,9 g/kg, Na=0,8 g/kg, Zn=42,6 mg/kg and Cu=7,5 mg/kg. Although regarding several elements the concentration of the mineral substances of the reed-grasses surpassed the values measured in the plants of the littoral zone, these can also be considered as normal. The chemical composition give the possibility to distinguish certain taxa, too.

Introduction

In view of the great economical and environmental protection significance of rivers the Hungarian flood vegetation is beign analysed systematically for several macro- and microelements. Besides many generalizable regularities (salt leaching and accumulation), in this manner such factors could also be identified, which restrain either the plant production, or the productivity of the animals consuming the hay of the flood-plains. There are detailed data on the whole Zala river (TÖLGYESI and KÁRPÁTI 1977) as well as the Hungarian upper reach of the Danube (KOZMA and TÖLGYESI 1979). The botanic and chemical surveying has also been carried out at many riverside sectors of the Hungarian upper (TÖLGYESI 1982) and middle reach (KOZMA and TÖLGYESI 1979, TÖLGYESI and KOZMA 1982) of the Tisza. The following review has been compiled from the area of the storage tank at Kisköre.

Materials and Methods

On June 30, 1982, 18 water plant samples were collected from the water of the Kisköre storage tank, and 54 littoral vegetation samples from the two sides of a canal deepened into the water basin. Following dehydration, the plants were digested in the mixture of HNO_3 and $HClO_4$ and the elements were mostly determined with the help of Perkin—Elmer 5000 type atomabsorption spectrophotometer. Divergent from this, the sulphur was measured turbidimetrically, the phosphorus with ammonium-molybdate, and the aluminium with eriochromecyanide colorimetrically.

Results

The 18 water plant samples representing 7 species (Table 1) did not incorporate into their organism more mineral substances than was earlier determined in Hungary

Table 1. *Composition of aquatic plants in dry matter collected from the storage tank at Kisköre.*

	K	Ca	P	S	Mg	Na	Al	Fe	Mn	Zn	Cu
	g/kg						mg/kg				
Nymphaea alba	26,7	8,4	3,37	3,2	1,16	13,78	518	525	356	31,6	3,8
Nymphaea alba	29,0	5,4	5,43	2,4	1,63	16,40	654	613	210	34,9	3,3
Trapa natans	14,8	27,3	4,16	3,6	7,28	3,58	280	521	414	52,6	9,9
Trapa natans	14,5	21,0	3,50	3,7	7,43	3,70	399	627	407	58,4	8,5
Trapa natans	12,0	20,1	3,43	3,9	5,88	2,95	527	592	412	59,6	8,2
Nymphoides peltata	25,7	6,4	3,69	2,9	3,49	6,94	501	1001	241	31,3	4,7
Nymphoides peltata	32,1	5,4	4,09	4,2	2,23	8,09	578	1375	150	47,8	8,2
Nymphoides peltata	31,7	5,8	4,70	3,9	2,79	7,63	391	663	190	35,7	5,4
Nymphoides peltata	12,2	2,0	2,44	3,5	1,07	2,21	727	486	161	35,2	8,0
Nymphoides peltata	19,7	5,0	3,43	2,9	2,27	2,66	756	596	490	51,0	6,0
Nymphoides peltata	25,8	5,4	3,83	3,2	2,52	5,48	731	1189	751	56,0	5,3
Polygonum amphibium	26,9	12,6	5,67	2,8	2,70	1,97	544	1410	339	51,6	8,7
Polygonum amphibium	25,9	27,6	6,09	2,8	2,95	1,96	637	1551	517	63,3	13,6
Potamogaton natans	30,1	10,7	4,35	4,5	2,45	7,05	421	1339	320	69,9	26,3
Potamogeton natans	26,7	8,2	3,96	4,1	3,31	7,55	584	1410	740	72,2	20,2
Potamogeton lucens	24,6	32,0	2,51	5,9	2,70	9,17	994	1269	659	64,6	23,7
Potamogeton lucens	7,4	8,4	2,51	4,9	1,10	2,91	1147	1269	520	42,1	12,4
Potamogeton pectinatus	13,1	4,0	2,11	2,9	1,21	3,36	909	1234	457	57,7	10,1

Table 2. *Composition of plants in dry matter collected from the storage tank at Kisköre.*

	K	Ca	P	S	Mg	Na	Al	Fe	Mn	Zn	Cu
	g/kg						mg/kg				
Iris pseudacorus	25,1	13,8	2,24	1,4	1,92	0,58	64	70	87	15,4	4,2
Amorpha fruticosa	14,1	8,5	3,17	2,3	1,61	0,37	34	74	22	30,7	13,6
Amorpha fruticosa	15,2	7,3	1,85	1,8	1,23	0,47	27	66	53	20,8	6,1
Trifolium hybridum	21,1	13,5	1,32	2,8	2,75	0,62	110	125	68	26,9	5,0
Vicia cracca	17,5	12,8	1,78	1,9	2,09	0,56	89	137	15	38,5	5,8
Chrysanthemum vulgare	30,0	7,9	1,71	1,9	1,51	0,31	72	117	30	24,4	7,2
Cirsium arvense	17,0	22,9	1,87	6,2	2,57	0,50	80	130	16	33,2	5,6
Eupatorium cannabinum	39,9	14,8	2,77	3,2	3,49	1,20	150	239	121	73,7	17,4
Inula salicina	30,6	13,0	2,47	3,4	1,48	0,79	78	110	50	42,3	6,8
Tussilago farfara	37,7	27,4	1,45	18,7	2,32	0,90	166	176	74	25,8	6,6
Mentha longifolia	25,6	9,0	1,32	2,3	1,62	0,73	129	137	29	10,7	4,7
Lycopus europaeus	30,7	10,0	1,87	2,7	2,61	0,70	91	47	47	56,9	12,7
Lycopus exaltatus	25,2	9,0	1,57	3,6	2,06	0,75	208	208	47	45,4	8,5
Stachys palustris	25,7	8,9	1,98	1,7	1,62	0,62	161	170	292	19,9	7,1
Aethusa cynapium	36,4	16,8	3,30	8,3	2,21	1,07	206	216	622	54,4	15,5
Sium latifolium	34,0	16,6	2,04	5,9	2,84	1,31	76	149	297	32,1	10,3
Polygonum lapatifolium	25,9	10,9	1,45	3,9	2,83	0,72	133	183	913	36,3	10,1
Rumex conglomeratus	14,0	8,2	1,85	2,2	2,28	0,83	76	127	113	20,0	3,3
Rumex palustris	19,4	8,3	1,81	1,9	3,48	1,99	85	104	78	22,1	5,7
Agrostis alba	13,1	2,3	1,25	1,5	0,74	0,51	136	163	132	15,8	3,0
Agrostis alba	13,9	2,2	1,91	2,2	1,20	0,17	30	86	22	28,6	3,8
Alopecurus geniculatus	16,8	3,9	1,58	1,9	1,02	0,12	76	94	181	41,2	71
Alopecurus pratensis	24,4	3,6	1,78	1,7	1,15	0,62	68	111	60	19,2	6,9
Glyceria maxima	23,8	5,4	1,78	2,5	1,26	0,43	48	113	30	23,7	7,9
Glyceria maxima	15,7	1,7	1,50	1,4	0,54	0,49	53	103	153	25,4	3,
Poa palustris	15,6	2,1	1,45	1,7	1,03	0,09	27	60	150	42,1	3,
Echinichloa hostii	24,3	3,2	2,18	3,0	2,04	0,90	40	115	199	45,9	6,1
Carex gracilis	18,1	3,4	1,03	1,9	1,33	0,28	68	89	203	44,4	4,3
Carex riparia	21,8	3,1	1,45	2,0	1,39	0,75	110	127	149	20,0	4,9
Carex vesicaria	17,7	5,9	0,99	1,9	1,65	0,17	127	136	209	18,8	4,7
Juncus effusus	19,5	2,5	1,45	2,5	1,37	0,26	110	122	111	48,9	7,5
Juncus effusus	21,4	2,3	1,71	2,1	1,22	0,46	561	881	156	37,1	8,2
Bolboschoenus maritimus	19,6	3,7	1,58	2,9	1,11	1,29	68	114	273	23,8	6,3
Shoenoplectus palustris	15,6	3,0	1,72	2,9	0,81	2,26	263	199	444	21,0	5,2
Typha angustifolia	24,0	8,2	1,85	3,2	0,97	3,17	30	58	345	22,9	5,4
Typha latifolia	24,1	12,4	1,45	1,8	0,98	1,62	115	133	1604	17.5	3.0

Typha latifolia	26,4	6,5	2,27	2,4	1,25	2,17	72	121	705	22,6	6,6
Butomus umbellatus	34,3	5,8	2,40	2,8	1,52	2,35	731	606	131	16,3	11,6
Lythrum salicaris	20,7	11,9	1,45	3,7	2,51	1,02	102	182	151	49,3	4,9
Euphorbia lucida	19,5	11,9	2,44	3,9	2,32	0,90	302	103	40	45,5	6,1
Euphorbia lucida	24,1	13,5	2,73	3,6	2,46	0,78	82	96	19	31,3	4,7
Veronica beccabunga	29,2	15,4	2,27	4,1	3,22	0,74	225	272	111	49,7	13,9
Echynocistys lobata	29,2	15,2	2,71	3,4	2,17	0,63	104	138	40	19,5	5,4
Equisetum arvense	24,7	15,5	2,31	8,8	4,48	0,63	108	110	30	49,2	8,2
Solanum dulcamar	31,3	8,6	2,51	2,8	2,07	0,71	60	104	97	36,9	11,3
Vitis riparia, fürt	23,3	11,3	2,90	2,4	2,22	0,66	31	72	29	39,6	10,1
Vitis riparia, levél	9,7	20,5	3,30	1,8	2,02	0,04	159	278	59	23,0	8,5
Vitis riparia,	15,7	8,7	2,31	0,9	1,79	0,71	36	70	19	27,8	8,2
Populus alba	20,5	10,7	2,44	3,9	2,17	0,46	69	173	33	250,0	10,1
Salix alba	21,6	14,2	2,18	3,9	2,16	0,65	127	145	106	209,3	8,5
Salix alba	18,5	9,6	2,18	2,9	2,07	0,93	115	143	192	148,4	19,7
Salix triandra	17,7	12,7	2,11	3,2	2,09	0,45	110	139	60	141,5	6,3

regarding manganese (KÁRPÁTI I., KÁRPÁTI V. and TÖLGYESI 1967) and other elements (TÖLGYESI 1965). These species contain larger amounts of most of the elements contrary to the terrestrial vegetation. Por example, in the present study, they absorbed into their organism 7,5 times as much sodium and 2,4 times as much manganese. The amount of aluminium and iron is also higher than in the terrestrial taxa. This is partly due to the fact that despite carefully washing in distilled water, silt fragments might have been retained on the plant surfaces. Owing to this methodological error which cannot be eliminated, the Al and Fe values can be regarded as the amount present in the plant; or an amount somewhat slighter, since the elements adhered to the surface are also included in the result.

There are several possibilities for the chemotaxon omicseparation of the collected plants. Thus, for example, the Nymphaea alba could be characterized by high Na-, and low Cu-concentrations. Besides its characteristically low K/Ca ratio, the Trapa natans is also striking by its large magnesium content. The *Polygonum amphibium*'s P/Mg ratio is the highest among the studied taxa. The *Potamogeton* genus is striking due to its high sulphuric and copper-contents. Significant correlation could be found between the manganese and copper concentrations, as well as the K- and Na-concentrations of the *Nymphoides peltata* collected from the six populations, situated far from each other. However, the taken up aluminium is in negative correlation with the total taken up macroelements, from these the relationship with sodium and phosphorus is even significant.

The littoral vegetation (Table 2) is in every respect of normal composition. The phosphorus content is moderate, and the sodium concentration is only also high in those species which also accumulate a large amount of Na in any other environment: *Bolboschoenus, Schoenoplectus, Typha, Butomus*. The manganese content is rather variant, being high at places. This, however, is by no means the result of anthropogenic effect. The manganese is present in well soluble, divalent, easily uptakeable form in the water-saturated, airless soils. The zinc content is averagely 42,6 mg/kg, that of copper is 7,5 mg/kg, not referring to loading at the time-point of the measurings.

The cause of a few striking values is not to be looked for in the exceptional ecological conditions, but is the taxonomical characteristic reviewed earlier. Thus, the high zinc concentration of Salicaceae (141—250 mg/kg), the high copper content of *Eupatorium cannabinum* (17,4 mg/kg), the high sulphur content of *Equisetum* (8,8 g/kg) are just the same chemotaxonomical characteristics, as is the fact that among the herbaceous species *(Gramineae, Juncaceae, Cyperaceae)* there is a prominence at the most in regard of the manganese content.

As a summary, it can be concluded that at the time-point of the present study, both the aquatic and terrestrial vegetation contained the mineral substances in the customary concentration. In a few cases the nutrient element levels do not even reach the concentration determined earlier in the vegetation of the Tisza flood-plain. Therefore, the determined values can be regarded as essential basic value to which the data to be measured in the future could be compared.

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Vízi és szárazföldi növényzet ásványanyagai a kiskörei tározóban

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Kivonat

1982 június végén 72 növénymintát elemeztünk meg 11 elemre. A lithorális zóna fajain kívü a nagyhínár *(Myriophyllo-Potametum)* és a tündérrózsa hínár *(Nymphaeetum albo-luteae)* fellelhető fajait is értékeltük. Ellentétben a Tisza hullámterében észlelt, aggodalomra is okot adó só- és nehézfém-akkumulációval, a tározó vizében és a szigetként kiemelkedő szárazulatokon a növényzet összetétele a megszokott. A kritikusabb elemekből az 54 szárazföldi minta átlaga: P=2,0 g/kg, Mg= =1,9 g/kg, Na=0,8 g/kg, Zn=42,6 mg/kg és Cu=7,5 mg/kg. Bár a hínárok ásványi anyagainak a noncentrációja több elem tekintetében meghaladta a parti zóna növényeiben mért értéket, ezek is kormálisnak tekinthetők. A kémiai összetétel lehetőséget nyújt egyes taxonok elkülönítésére is.

Минеральные вещества водной и полевой растительности водохранилища Кишкёреи

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Резюме

В конце июня 1982 года был проведен анализ 72 растительных проб на 11 элементов. Кроме видов литоральной эоны, проводилась оценка и встречающихся здесь видов *Myriophyllo-Potametum* и *Nymphaeetum albo-luteae*.

В противоположность отмеченной в долине Тисы и вызывающей опасение аккумуляции солей и тяжёлых металлов, состав растительности как в воде, так и на выступающих в виде осторовов участках суши является обычным. На основе 54 полевых проб установлено следующее среднее содержание критических элементов: P=2,0 г/кг, Mg=1,9 г/кг, Na=0,8 г/кг, Zn=42,6 мг/кг, Cu=7,5 мг/кг. Хотя концентрация минеральных веществ в водорослях в случае многих элементов превзошла соответствующие показатели побережной зоны, её тоже следует считать нормальной.

Neorganske materije u vodenim i suvozemnim biljkama na području akumulacija Kisköre

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Abstrakt

Krajem juna 1982. godina analizirana su 72 uzorka biljaka na prisustvo 11 elemenata. Osim vrsta litoralne zone ispitivane su i vrste *Myriophyllo-Potametum* i *Nymphaeetum albo-luteae* zajednice. Nasuprot zabrinjavajućoj akumulaciji soli teških metala u plavnoj zoni Tise, količina ovih sastojaka u biljkama u vodi akumulacija i na sprudovima je zadovoljavajuća. Prosek kritičnih elementana u 54 suvozemne probe je: P=2,0 g/kg, Mg=1,9 g/kg, Na=0,8 g/kg, Zn=42,6 mg/kg i Cu=7,5 mg/kg. Iako koncentracija mineralnih materija u zajednici *Myriophyllo-Potametum,* u pogledu više elemenata, nadmašuje vrednosti merene u priobalnim biljkama, ona se ipak kreće u granicama normale. Hemijski sastav daje mogućnost i za odredjivanje nekih taksona.